

LASER PROJECTION DISPLAY AND ILLUMINATION DEVICE WITH MEMS SCANNING MIRROR FOR INDOOR AND OUTDOOR APPLICATIONS

Yee-Chung Fu

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application Serial No. 10/613,397, filed on July 3, 2003, ^{now abandoned}, and incorporated herein by reference.

FIELD OF INVENTION

[0002] The invention relates to an image projection apparatus employing micro-electro-mechanical system (MEMS) scanning mirrors and laser light sources.

DESCRIPTION OF RELATED ART

[0003] Various display systems have been developed for illuminating graphics for indoor and outdoor advertisement and entertainment. Some examples of these display systems include illuminated billboards, light-emitting diode (LED) displays, neon light signs, and liquid crystal flat-panels. These display systems typically consume substantial electrical power and are bulky in construction. Thus, substantial efforts are spent to transport, set up, power, and maintain these display systems. In addition, some of these display systems cannot display images with sufficient brightness to be visible indoor under illumination or outdoor under daylight.

[0004] Image projection systems utilizing digital micromirror device (DMD), liquid crystal display (LCD) panel, and liquid crystal on silicon (LCoS) technologies are capable of displaying high quality images indoors. These devices typically use two types of high power bulbs, halogen and metal halide, whose lifetime is approximately in the range of 2,000 to 6,000 hours. The lifetime of these bulbs presents a challenge against the constant use of these systems to display images. On the other hand, the lifetime of solid state lasers are over 50,000 hours, an order of magnitude longer than the halogen and metal halide bulbs.

[0005] Solid state lasers are known to produce high brightness and saturated colors with low power consumption. Lasers can be used very effectively in laser projection systems, including